



Improving Medical Performance

(Management Information Systems)



Lecture 5



THE AMERICAN
UNIVERSITY IN CAIRO

SCHOOL OF
BUSINESS

EXECUTIVE EDUCATION

Management Information Systems



ILO's

By the end of this session, participants should be able to:

- ❑ Identify & Recognize Management Information Systems as regards:
 - Purposes
 - Medical Records(Hospitals) equations
 - Sampling
- ❑ Statistical Process Control
- ❑ Control Charts
- ❑ Pareto Diagram



Purposes of Information Systems :

1. **Clinical** Information Systems,
2. **Administrative Support** Information Systems,
3. **Management or Decision Support** Systems.



* Clinical ISs include :

1. EMR
2. Patient care management
3. Order entry
4. Results reporting
5. Nursing services
6. Departmental clinical management
7. Laboratory services
8. Pharmacy services
9. Radiology services
10. Clinical decision support



* Administrative ISs support :

1. Patient registration
2. Financial management
3. Human resource management
4. Materials management
5. Facilities management



* Decision or Management support systems :

1. Executive decision making
2. Financial modeling
3. Planning and marketing
4. Resource allocation (labor, supplies, and facilities planning)
5. Expert systems



Statistical Definitions

❑ NEWBORNS

ARE CALCULATED SEPARATELY AND NOT INCLUDED IN THESE CALCULATIONS .



Average Length of Stay of Discharged Patients (ALOS) = days

- This is calculated by Total inpatient service days of discharged (including deaths) patients for a given period
/ Total number of discharges alive and dead in the same period.



Bed Occupancy Rate (inpatient) = %

- { Inpatient Service Days / Bed days (Beds available x number of days for period of calculation) } X 100



Hospital Death Rate= %

- { Number of deaths of inpatients in a period /
 Number of discharges (including deaths) in the
 same period } X 100



Exercise (1)

In one of the Internal Medicine departments there were 40 beds set-up and staffed for use. 600 patients were admitted in the 2nd Quarter of the year 2008.

The inpatient service days for the same period was 2400

Find the bed days & the occupancy rate of this department in the same quarter

Answer (1)

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Exercise (2)

In June, a hospital discharged 6700 patients (including deaths, but excluding newborns).
The combined inpatient service days were 26 800 days.
Find the average length stay of inpatients during June.

Answer (2)

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Exercise (3)

In January there were 310 deaths. A total of 7500 patients were discharged
(including deaths)

Find the hospital death rate for January

Answer (3)

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What is Sampling?

- ❑ Procedure by which some members of a population are selected as representative of the entire population
- ❑ The sub-group thus selected to represent the whole population is known as **SAMPLE**



Sampling

Measuring a sample is a simple
efficient way to understand how the
system is performing

Sampling **saves time & resources** while
accurately **tracking Performance**



WHY SAMPLING?

- ❑ Unable to study all members of a population
- ❑ Saves time and money
- ❑ Feasible
- ❑ Measurements may be better in sample than in entire population
- ❑ Reduces bias



Basic Sampling Designs

- ❑ A population (N) is the total aggregate or group (e.g., all cases that meet a designated set of criteria for practitioners, all patients who have died at a particular hospital, or all registered nurses with a experience of 10 years or more).
- ❑ Sampling makes research more feasible because it allows researchers to sample a portion of the population to represent the entire population (n).



Sample Size

***With the exception of case studies,
*the larger the sample, the more valid and
accurate the study*, because a larger
sample size is more likely to be more
representative of the population.



Types of Sampling

Random/Probability

- ❑ Simple random sample
- ❑ Systematic random sample
- ❑ Cluster sampling
- ❑ Stratified random sample
- ❑ Multi-Stage sampling.
- ❑ Others

Non Probability Non Random

- ❑ Convenience sample
- ❑ Purposive or judgment sampling
- ❑ Snow ball sample
- ❑ Quota sample
- ❑ Expert sampling



Probability sampling

1) Simple random sampling:

Each individual in the sampling frame (all subjects in the population) **has an equal chance** of being chosen. For example, pulling a name out of a hat containing all possible names. With large sample frame use tables of Random numbers (or simple computer program)

Also called unrestricted random sampling



2) Systematic Random sampling:

- ❑ This method involves drawing every nth element from a population.
- ❑ For example, picking every third name from a list .
- ❑ Also called ;
Quasi-random sampling



3) Stratified random sampling.

- ❑ A subpopulation is *a stratum*, and strata are two or more homogeneous subpopulations.
- ❑ After the population has been divided into strata, *each member of a stratum has an equal probability of being selected.*

Examples of strata include sex, ethnicity, patients with particular diseases, or patients living in certain parts of the country.



4) Cluster sampling.

This method requires that the population be divided into **groups, or clusters**.

For example, if a researcher is studying medical students, she or he may not have individuals' names but may have a list of medical schools in the area.

The sample may therefore be randomly derived from this list of medical schools.

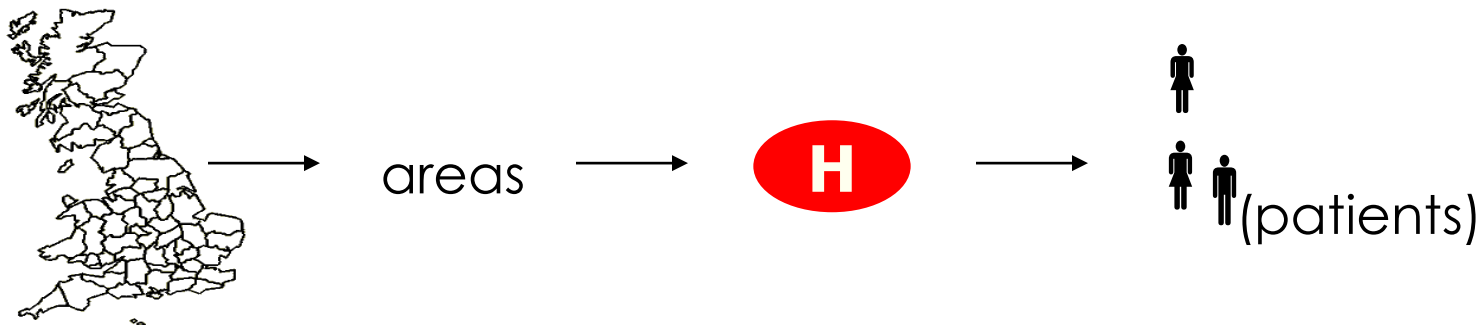


Multi-stage sampling

Different sampling units are sampled at different stages

Example

Geographical areas of the UK would randomly be selected, from which **hospitals** would be randomly selected from which **wards/patients** would then be randomly selected.





B-Non Probability Sampling

- ❑ An **intentionally biased** way to sample involving **qualitative judgment** about an issue **suspected** to be common or widespread.
- ❑ The probability of being included in the sample is not known and not equal for the sampling units
- ❑ Examination of relatively few cases is assumed to be enough to reveal the nature of any problem and its possible causes. (**Brainstorming**)



1-Convenience sampling.

Allows the use of *any available group* of subjects.

Example: All patients seen in the ED in a given week.



1-1...Snowball sampling.

- ❑ This is a subtype of convenience sampling. It involves subjects suggesting other subjects for inclusion in the study, so that the sampling process gains momentum.
- ❑ **Used when subjects are difficult to identify**, but are known to others because of an informal network.





2-Accidental Sampling

- ❑ The "person on the street" interviews conducted frequently by television news programs
- ❑ Sampling those most convenient
- ❑ Gets a quick reading of public opinion
- ❑ Also called Haphazard Sampling



3-Voluntary sampling

- ❑ The sample is self selected
- ❑ Sample consists of people who chose themselves by responding to a general appeal.
- ❑ They often over represent people with strong opinions, most often negative opinions.



4-Purposive or judgment sampling.

- ❑ This method selects a particular group because they represent a desired characteristic.
- ❑ This method is subjective, and the researcher uses judgment to decide who is representative of the population.
- ❑ Example: All patients over age 60 with total hip replacement



4-1..Expert sampling:

- ❑ This is a type of *purposive sampling* that involves selecting *experts* in a given area because of their access to the information relevant to the study.
- ❑ Expert sampling is used in the *Delphi technique*, in which several rounds of questionnaires are distributed on the selected topic and sent to experts to elicit their responses, and are sent out again after the initial data analysis.
- ❑ The goal is to achieve fairly rapid group consensus

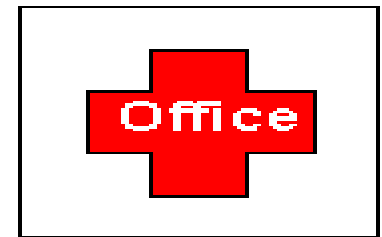


5 -Quota sampling:

- Portions or percentages of persons/cases in a stratified population (subset) ,
e.g., 10% of male patients with Diabetes and heart disease over age 55.



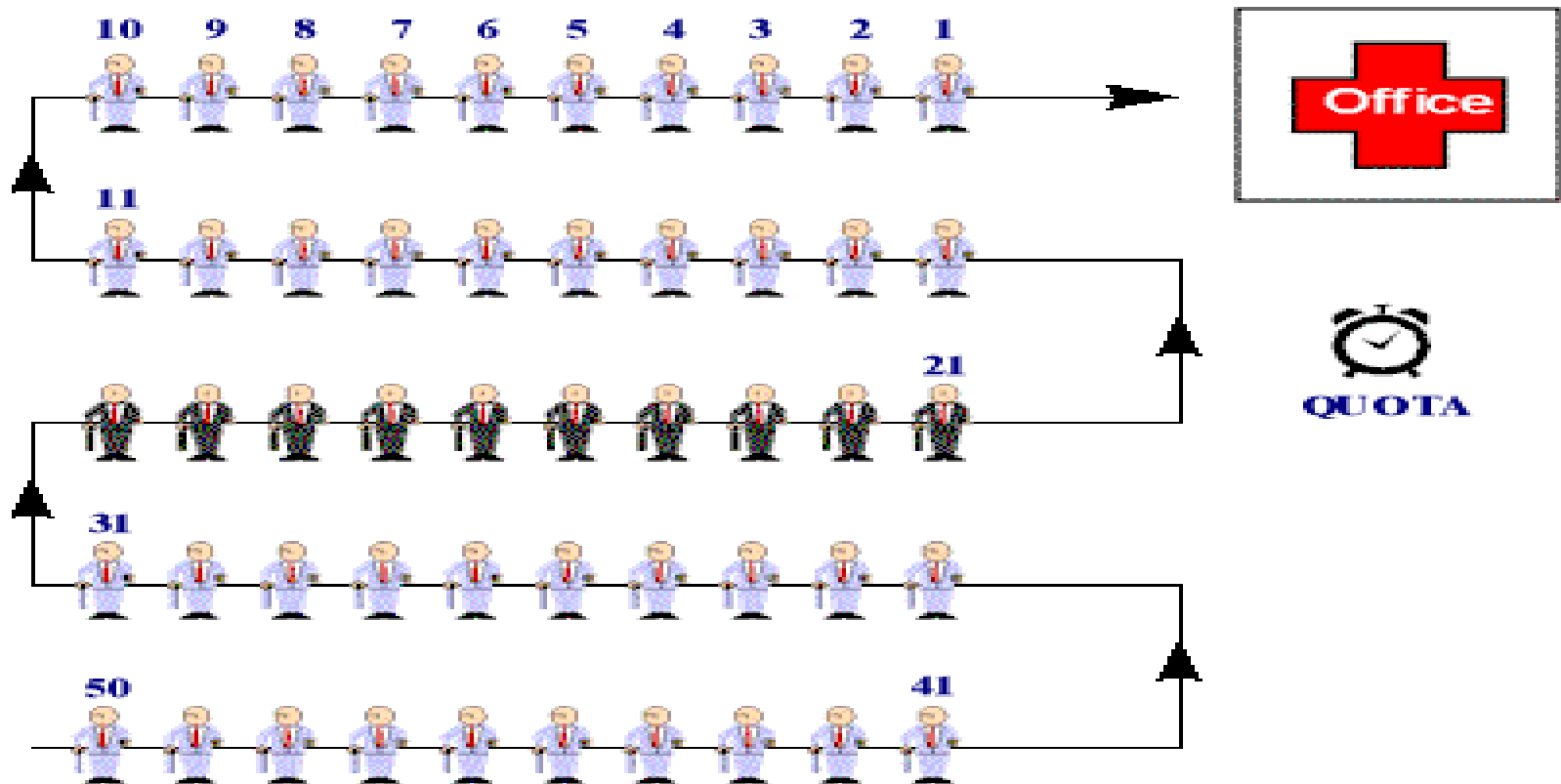
WHAT TYPE OF SAMPLING IS THIS?



Systematic
Random
sampling



WHAT TYPE OF SAMPLING IS THIS?





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Data & Statistics



Data:-

- Un-interpreted or raw observations or facts
- Examples:-
 - Number of patients in OPD.
 - Number of laboratory tests
 - Number of employees in an organization





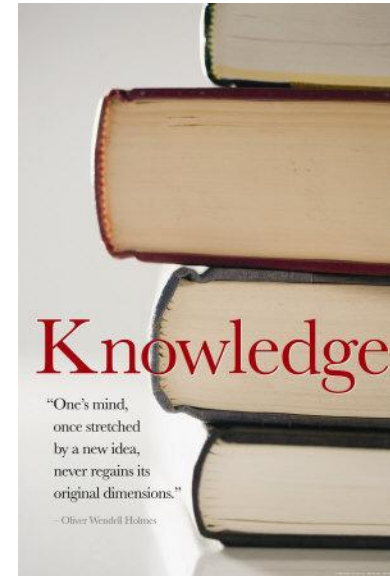
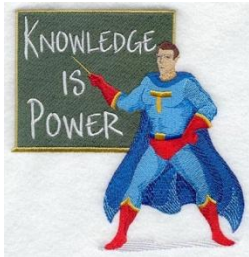
Information:-

- Is data transformed through analysis & interpretation into a useful form for decision making.
- Examples:-
 - Mortality rate
 - % of patients in surgery OPD in March.
 - Infection rate



Knowledge:-

- Information + Experience



- Decision making must be related to.....



DATA

By analysis



INFORMATION

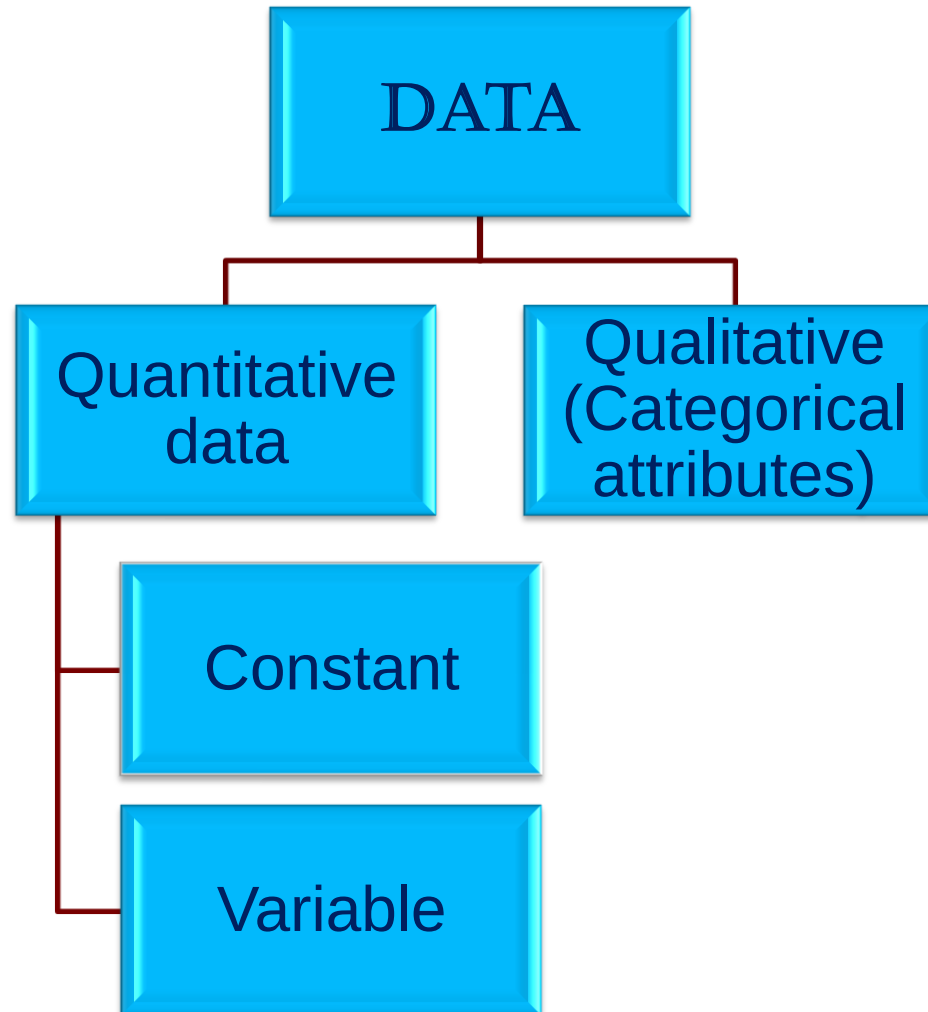
+ experience



KNOWLEDGE



DECISION MAKING





Quantitative data

❑ Constant Data:-

Speed of sound or speed of light

❑ Variable data:-

✓ Continuous variable data:-

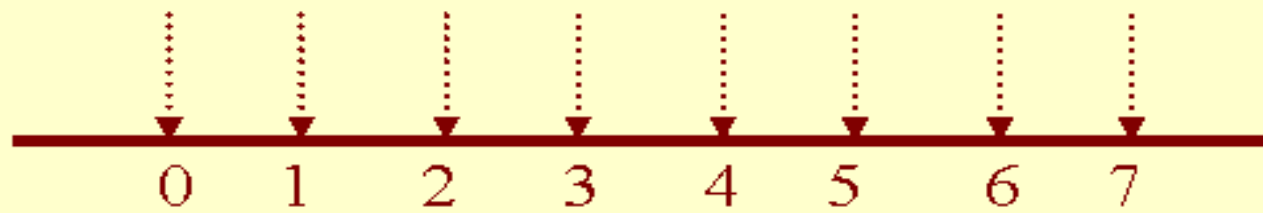
- Data can be measured or counted in whole & fractional units.
- Examples:-
Blood pressure, height, weight, temperature, time, money, blood glucose level.



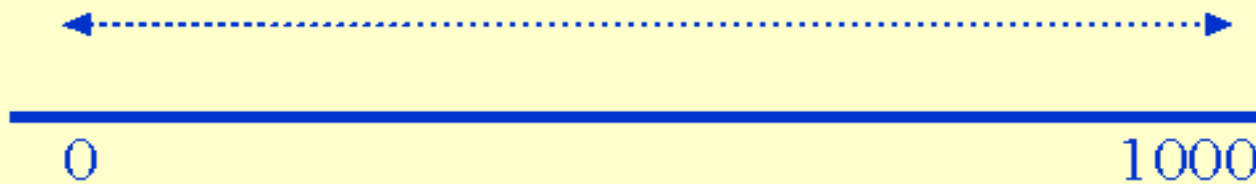
- ✓ Discrete variable data:-
 - Usually count data, integral values & can not be fractured.
 - Examples:-
Number of visits, number of patients,.....



Discrete data -- Gaps between possible values

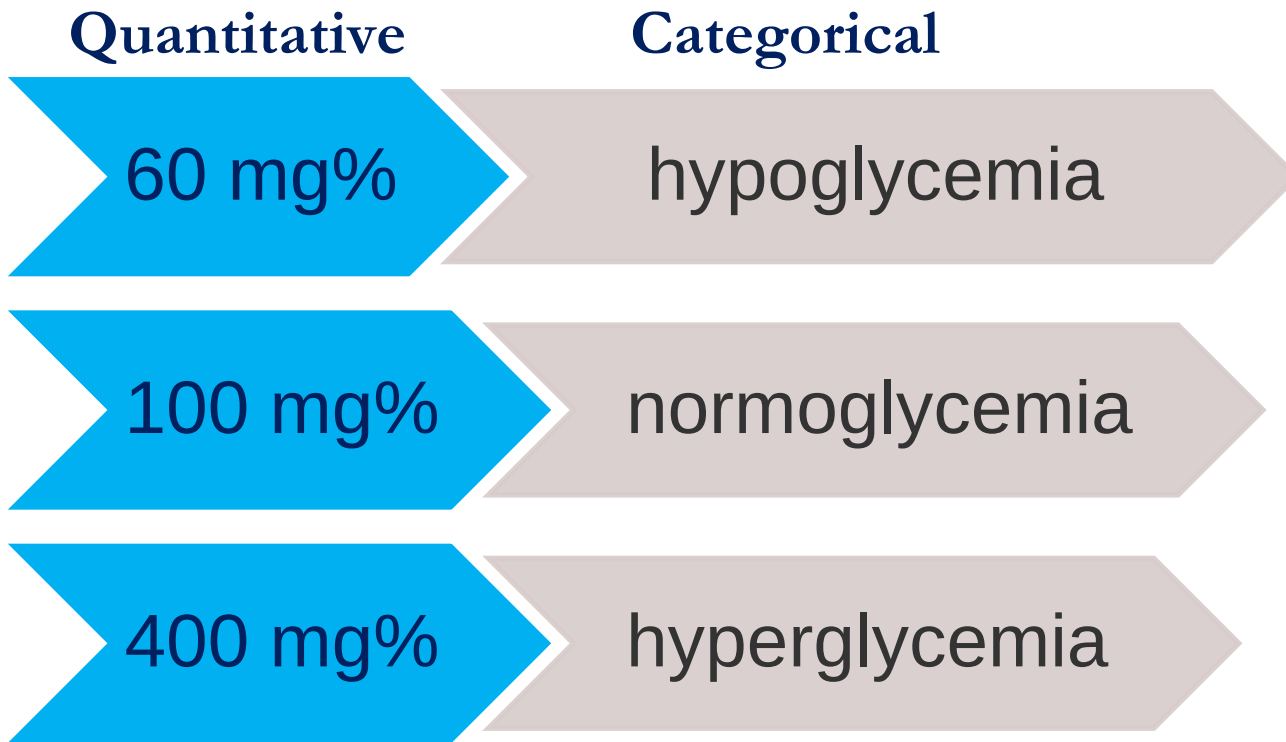


Continuous data -- *Theoretically,*
no gaps between possible values





Quantitative data could be changed into categorical data
As in blood glucose level





Methods of Data presentation

1-Textular Method

2- Tabular Method

3- Semi-tabular Method

4- Graphical Method



PARETO DIAGRAMS

- It puts data in a hierarchical order which allows the most significant problems to be correct first
- Quality experts often refer to the principle as the **80-20 rule**; that is, **80%** of problems are caused by **20%** of the potential sources.
- To create a Pareto diagram, the operator collects random data, regroups the categories in order of frequency, and creates a bar graph based on the results.



Impact matrix for external customers

External Customers	Criteria					Total
	New business opportunity	Reputation	Total revenue	Ability to shut down	Competition Ranking	
Patients	9	9	9	3	9	39
Patients' families	91	9	3	0	9	30
Referring Physicians	3	3	3	0	1	10
Ministry of Health (MOH)	3	9	3	9	9	33
Payers (insurance companies)	0	3	0	3	3	9
Regulators	1	1	0	9	0	11
Community	1	0	0	3	3	7
Media	0	1	0	1	9	11
Syndicates	3	3	1	1	0	8
Health insurance organization (HIO)	9	9	3	0	9	30
Suppliers(57357 Hospital)	1	9	3	0	3	16

9 = Major impact

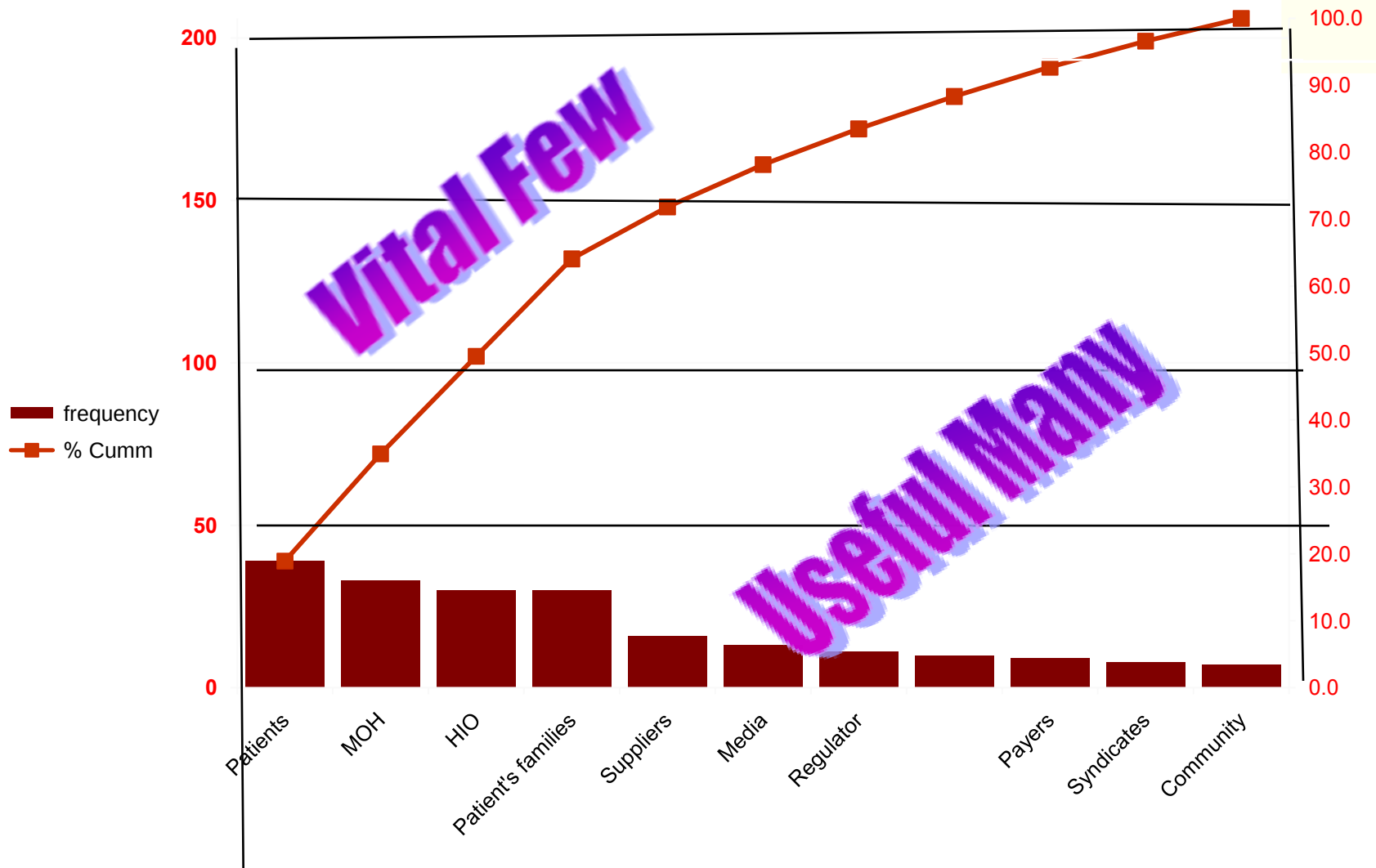
3 = Moderate impact

1 = Small impact

0 = No impact



Item	frequency	cumm	Cumm %
Patients	39	39	18.9
MOH	33	72	35.0
HIO	30	102	49.5
Patient's families	30	132	64.1
Suppliers	16	148	71.8
Media	13	161	78.2
Regulator	11	172	83.5
Referring physicians	10	182	88.3
Payers	9	191	92.7
Syndicates	8	199	96.6
Community	7	206	100
	206		





Control Chart



Walter Shewhart

Developer of Control Charts in the late 1920's



CONTROL CHARTS

- ❑ It is a line graph
- ❑ The centerline is the mean and the distance a data point is from the centerline is used to define special cause variation
- ❑ The formula used to calculate the upper & lower control limits is specific to each type of control chart
- ❑ **Note:- On a run chart the centerline is the median** and the distance of a data point from the centerline is not important to interpretation



All control charts have three basic components

- A centerline, usually the mathematical average of all the samples plotted.
- Upper and lower statistical control limits that define the constraints of common cause variations.
- Performance data plotted **over time**.



Control Chart for Variables



Construction of control charts

■ STEP 1: Collect data

m samples of n units are selected for controls

m = number of samples

n =variables of each sample, so, if there are X1,X2,X3 for each sample. $n = 3$

■ STEP 2: Plot data

In every case, the X-axis of a control chart represents sample numbers. For the Y-axis, data plotted depends on the chart type:



Worked out example

- As an example, we illustrate the measured pH values of a liquid. Tests occur three times per day, during 24 days. Each sample contains three values and there are 24 samples. Here are the results:

Sample	X_1	X_2	X_3
1	6	5.8	6.1
2	5.2	6.4	6.9
3	5.5	5.8	5.2
4	5	5.7	6.5
5	6.7	6.5	5.5
6	5.8	5.2	5
7	5.6	5.1	5.2
8	6	5.8	6
9	5.5	4.9	5.7
10	4.3	6.4	6.3
11	6.2	6.9	5
12	6.7	7.1	6.2

Sample	X_1	X_2	X_3
13	6.1	6.9	7.4
14	6.2	5.2	6.8
15	4.9	6.6	6.6
16	7	6.4	6.1
17	5.4	6.5	6.7
18	6.6	7	6.8
19	4.7	6.2	7.1
20	6.7	5.4	6.7
21	6.8	6.5	5.2
22	5.9	6.4	6
23	6.7	6.3	4.6
24	7.4	6.8	6.3



Y- axis of a control chart

Formulas

For an Xbar-chart:

Averages
of the quality
characteristic over a
sample of n units

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

For an R-chart:

Ranges
of measures in a
sample of n units

$$R = \text{MAX}(X_i, i=1..n) - \text{MIN}(X_i, i=1..n)$$



■ STEP 3: Compute the central line and control limits:

	Central line		Control limits	
Xbar-chart	<u>Average</u> on m samples of the quality characteristic averages over n units tested per sample	$\bar{\bar{X}} = \frac{\sum_{j=1}^m \bar{X}_j}{m}$	$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \bar{R}$	$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \bar{R}$
R-chart	<u>Average</u> on m samples of the ranges calculated for each sample of n units	$\bar{R} = \frac{\sum_{j=1}^m R_j}{m}$	$UCL_R = D_4 \bar{R}$	$LCL_R = D_3 \bar{R}$

Coefficients (A_2, D_3, D_4) present in formulas depend on the sample size n and are tabulated in quality books.



STEP 1: Collect the data

There are 24 samples of 3 measures each. The table is written on a spreadsheet (m = 24 & n = 3).

STEP 2: Compute values to plot (averages Xbar and ranges R)

We build a table using built-in functions to compute averages (Xbar) and ranges (R) for each sample:

For Xbar

	A	B	C	D	E	F
1	Sample	X_1	X_2	X_3	X-bar	
2	1	6	5.8		=AVERAGE(B2:D2)	
3	2	5.2	6.4	6.9	AVERAGE(number1; [number2]; ...)	
4	3	5.5	5.8	5.2		

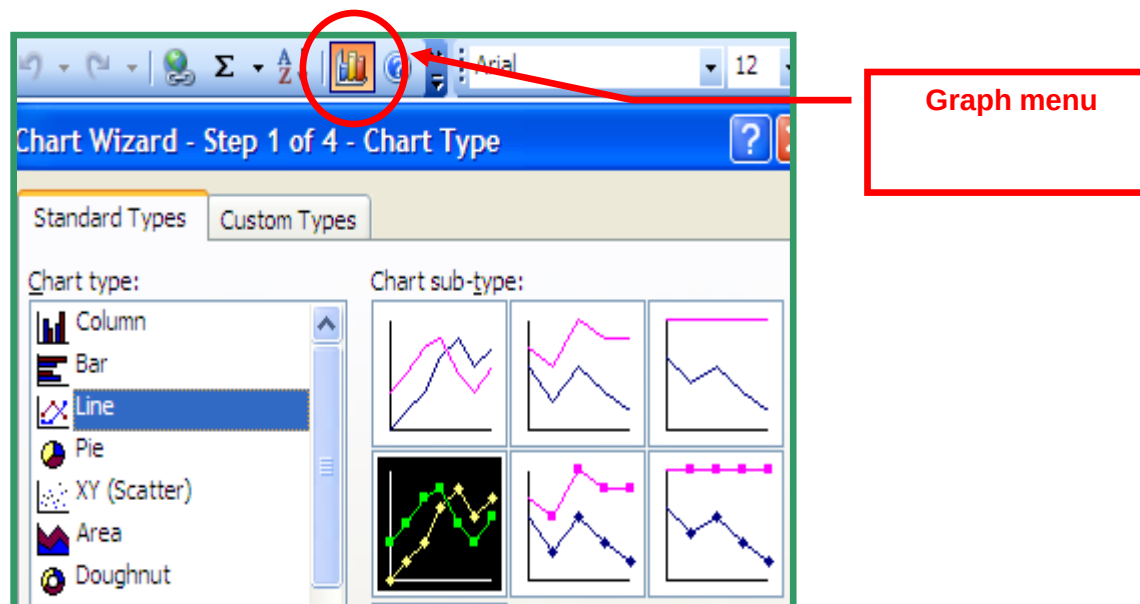
For R

	A	B	C	D	E	F	G	H
1	Sample	X_1	X_2	X_3	X-bar	R		
2	1	6	5.8	6.1		=MAX(B2:D2)-MIN(B2:D2)		
3	2	5.2	6.4	6.9		MIN(number1; [number2]; ...)		
4	3	5.5	5.8	5.2				



STEP 3: Compute central line and limits

- Columns are used to compute the central line and the control limits. For each sample, we write the expression of the formula needed (for central line and limits)
- Control charts can finally be drawn.

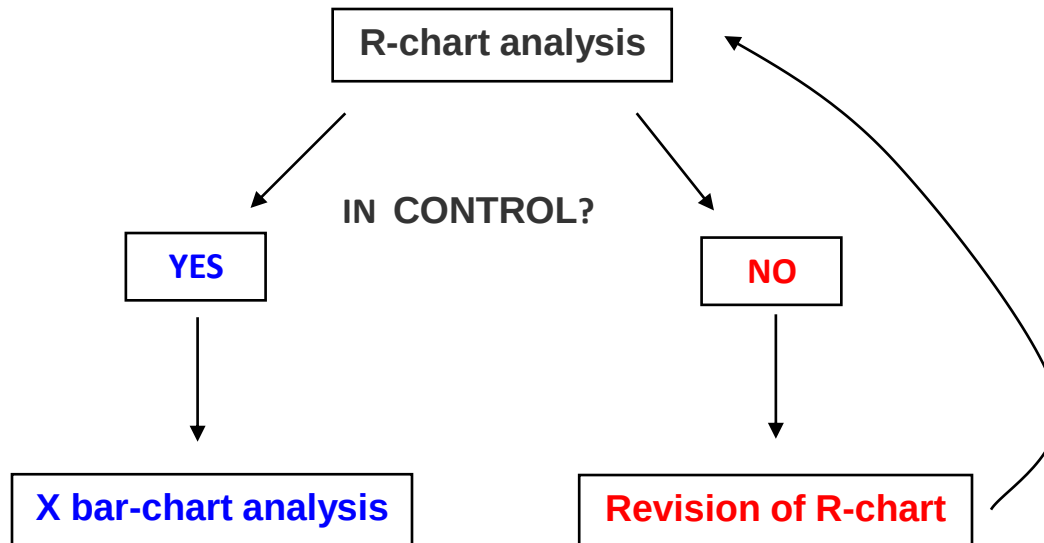




Analysis of control charts

Process analysis:

- First of all, the study always starts with the R-chart. If the R-chart shows a process in control, then the X bar-chart can be analyzed (not before) as the following scheme shows.





Sample Size (n i)	A2	D3	D4
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777
11	0.285	0.256	1.744
12	0.266	0.284	1.716
13	0.249	0.308	1.692
14	0.235	0.329	1.671
15	0.223	0.348	1.652
16	0.212	0.364	1.636
17	0.203	0.379	1.621
18	0.194	0.392	1.608
19	0.187	0.404	1.596
20	0.180	0.414	1.586
21	0.173	0.425	1.575
22	0.167	0.434	1.566
23	0.162	0.443	1.557



Informal assignment 5 (to be sent by MAIL ONLY+ Individual)

Please Read & Demonstrate Briefly :

1. John Kotter Change Model
2. Kurt Lewin Change Model
3. Healthcare Organizations as Complex Systems .